〔Med. Entomol. Zool. Vol. 60 No. 4 p. 259–268 2009〕

Two new and one newly recorded species of *Simulium* (*Gomphostilbia*) (Diptera: Simuliidae) from southern Thailand

Hiroyuki TAKAOKA[1], Yasushi OTSUKA[1], Wej CHOOCHOTE[2], and Sorawat THONGSAHUAN[2]

[1] *Department of Infectious Disease Control, Faculty of Medicine, Oita University, Hasama, Yufu City, Oita, 879–5593 Japan*
[2] *Department of Parasitology, Faculty of Medicine, Chiang Mai University, Chiang Mai 50200, Thailand*

(Received: 26 June 2009; Accepted: 7 August 2009)

Abstract: Two new species of *Simulium* (*Gomphostilbia*) are described based on pharate adult specimens and their pupal exuviae collected from Surat Thani Province, southern Thailand. *Simulium* (*G.*) *datfaense* sp. nov. is characterized by the pupal gill composed of one long and seven short filaments arranged as 3+3+2 lying horizontally from inside to outside. *Simulium* (*G.*) *otsukai* sp. nov. is also distinctive in having the eight pupal gill filaments arranged as 1+1+2+[1+(1+2)] from dorsal to ventral. *Simulium* (*G.*) *cheongi* is recorded for the first time from Thailand.

Key words: black fly, Simuliidae, *Simulium*, Thailand, new species

Simulium (*Gomphostilbia*) is one of the two predominant subgenera in Thailand, as in other countries of tropical Asia, which is now represented by 20 of 75 named species of the genus *Simulium* so far recorded from Thailand (Adler and Crosskey, 2009).

In this paper, two more new species of this subgenus are described based on pharate adult specimens and their associated pupal exuviae and cocoons collected in Surat Thani Province, southern Thailand, and one known species, *S.* (*G.*) *cheongi* originally described from Peninsular Malaysia (Takaoka and Davies, 1995), is added as a new record from Thailand.

The terms for morphological features used here follow those of Takaoka (2003). The type specimens of these new species are deposited at the Department of Infectious Disease Control, Oita University.

Simulium (*Gomphostilbia*) *datfaense* Takaoka and Otsuka sp. nov.

DESCRIPTION. **Female** (dissected out). Only the following features are observable: Body length 2.5 mm. ***Head***. Frons dark brown, densely covered with whitish-yellow fine hairs intermixed with several dark brown hairs along each lateral margin; frontal ratio 1.70 : 1.00 : 3.05. Fronto-ocular area well developed, elongate, directed laterally and upwardly. Clypeus dark brown, densely covered with whitish-yellow fine hairs intermixed with several dark brown stout hairs on each side of lower 1/2. Antenna composed of scape, pedicel and 9 flagellomeres. Maxillary palp with 5 segments; 3rd segment (Fig. 1A) somewhat swollen; sensory vesicle (Fig. 1A) ellipsoidal, 0.36 times as long as 3rd segment, and with medium-sized opening apically. Maxilla with 9 or 10 inner and 12 or 13 outer teeth. Mandible (Fig. 1B) with 25 inner and 7 or 8 outer teeth though outer margin not serrated near apex. Cibarium (Fig. 1C) medially with short broad sclerotized projection folded forward from pos-

terior margin, and with well-sclerotized longitudinal ridge medially. ***Thorax***. Scutum medium to dark brown, with 3 faint longitudinal dark vittae, densely covered with whitish-yellow recumbent hairs. Scutellum light brown, with whitish-yellow short hairs and several dark long upright hairs. Postnotum dark brown, bare. Pleural membrane bare. Katepisternum with dark hairs. ***Legs***. Coloration incomplete. Fore basitarsus slightly dilated, 6.78 times as long as its greatest width. Hind basitarsus (Fig. 1D) nearly parallel-sided. Calcipala (Fig. 1D) well developed. Pedisulcus developed. Claw (Fig. 1E) with large basal tooth 0.52 times as long as claw. ***Wing***. Costa with 2 parallel rows of dark brown spinules and hairs except basal portion with patch of yellow hairs. Subcosta haired except near apex bare. Hair tuft of stem vein mostly yellow. Basal portion of radius fully haired; R_1 with dark brown spinules as well as dark brown hairs; R_2 with hairs only. Basal cell absent. ***Genitalia***. Sternite 8 (Fig. 1F) bare medially, furnished with 32 long stout hairs as well as 4 short hairs on each side. Ovipositor valves (Fig. 1F) triangular, rounded posteromedially, thin, membranous except inner margin narrowly sclerotized, covered with 1 short seta as well as numerous microsetae except narrow area along posterior margin bare and transparent; inner margins moderately separated from each other. Genital fork (Fig. 1G) inverted-Y-shaped, arms of moderate width, strongly folded posterolaterally. Paraproct in lateral view (Fig. 1H) short, somewhat produced ventrally beyond level of cercus, covered with about 20 stout hairs on ventral and outer surfaces; anteromedial surface with 5 or 6 sensilla. Cercus in lateral view (Fig. 1H) short, about half as long as its width, sparsely or moderately setose. Spermatheca (Fig. 1I) ellipsoidal, 1.32 times as long as its greatest width, strongly sclerotized except narrow area at juncture with duct unsclerotized, with reticulate surface patterns near juncture as well as many fissures on most other portions, and without internal hairs.

Pupa. Body length about 2.7 mm. ***Head***. Integument light brown, moderately covered with round tubercles; antennal sheath normal, with no spinous projections and almost bare; frons with 3 pairs of simple very long trichomes and face with pair of simple very long trichomes. ***Thorax***. Integument yellowish-brown, moderately covered with round tubercles on anterior 1/2 and with smaller tubercles on posterior 1/2; thorax with 3 pairs of simple very long trichomes anterodorsally, with 2 pairs of simple very long trichomes anterolaterally, with 1 pair of trichomes posterolaterally (lost except basal portion, then length not measurable), and with 3 pairs of simple trichomes (2 medium-long, 1 long) ventrolaterally. Gill (Fig. 2 A) composed of 8 thread-like filaments arranged in 3 groups (3+3+2 filaments lying nearly horizontally from inside to outside) arising at base; inner triplet consisting of 1 individual and 2 paired filaments with very short stalk, middle triplet consisting of 3 individual filaments arising nearly at same level from short stalk or 1 individual and 2 paired filaments with very short stalk, and outer paired group with stalk of moderate length and composed of 1 long and stout outer filament and short slender inner filament; stalk of middle triplet 0.7–1.0 times as thick as that of outer paired group; 6 filaments of inner and middle triplet groups and 1 inner filament of outer paired group each markedly tapered near base (though 2 paired filaments of inner triplet group tapered to less extent than others), then nearly of same thickness, and all these filaments subequal in length to one another (0.8–1.0 mm long); outer filament of outer paired group tapered gradually toward apex and much longer than 7 other filaments (though its exact length not measurable due to loss of apical portion; length of remaining portion from base to broken point is 1.4 mm); all filaments yellowish-brown to light brown, with annular ridges and furrows though ridges less marked on apical portions and covered with minute tubercles. ***Abdomen***. Dorsally, segments 1 and 2 light yellow and not tuberculate; segment 1 with 1 simple slender medium-long seta on each side; segment 2 with 1 simple slender medium-long seta and 5 simple slender short setae submedially on each side; segments 3 and 4 mostly unpigmented, each with 4 hooked spines and 1 simple slender short seta on each side; segment 5 lacking spine-combs; segments 6–9 each with distinct spine-combs in transverse row, together with comb-like groups of minute spines on each side; segment 9 light yellow, not tuberculate, with pair of distinct broad terminal hooks moderately serrated on outer margin (Fig. 2 B). Ventrally, segment 3 with few simple slender minute

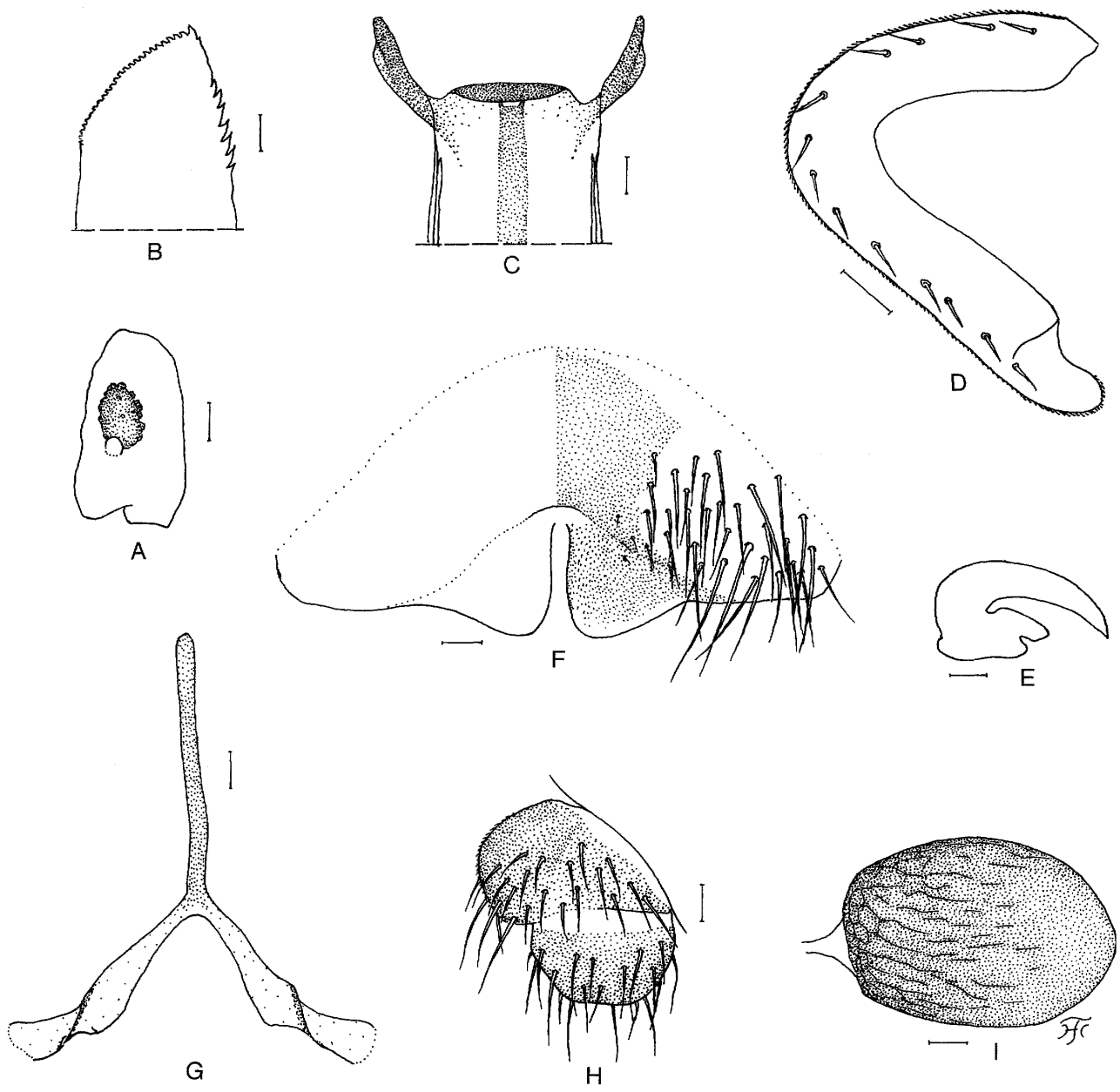

Fig. 1. Female of *Simulium* (*Gomphostilbia*) *datfaense* sp. nov. A, 3rd segment of maxillary palp with sensory vesicle (left side and front view); B, mandible; C, cibarium; D, hind basitarsus showing calcipala (left side and outer view); E, claw; F, sternite 8 and ovipositor valves (ventral view); G, genital fork (ventral view); H, paraproct and cercus (left side); I, spermatheca (lateral view). Scale bars. 0.05 mm for D; 0.02 mm for A, C and F–I; 0.01 mm for B and E.

setae; segment 4 with 1 simple or bifid medium-long hooklet and few simple slender short setae on each side; segment 5 with pair of bifid hooks submedially and few simple slender short setae on each side; segments 6 and 7 each with pair of bifid inner and simple outer hooks somewhat separated from each other, and few simple slender short setae on each side. Each side of segment 9 with 3 grapnel-like hooklets.

Cocoon (Fig. 2 C, D). Wall-pocket shaped, moderately woven with anterior margin slightly thickly woven (though anterior portion not thickly woven and with minute open spaces in webs in 1 cocoon), without anterodorsal projection; posterior 1/2 with floor moderately woven; individual threads well visible; 3.0 mm long by 1.2 mm wide.

Male and **Mature larva**. Unknown.

TYPE SPECIMENS. Holotype pharate female with associated pupal exuviae

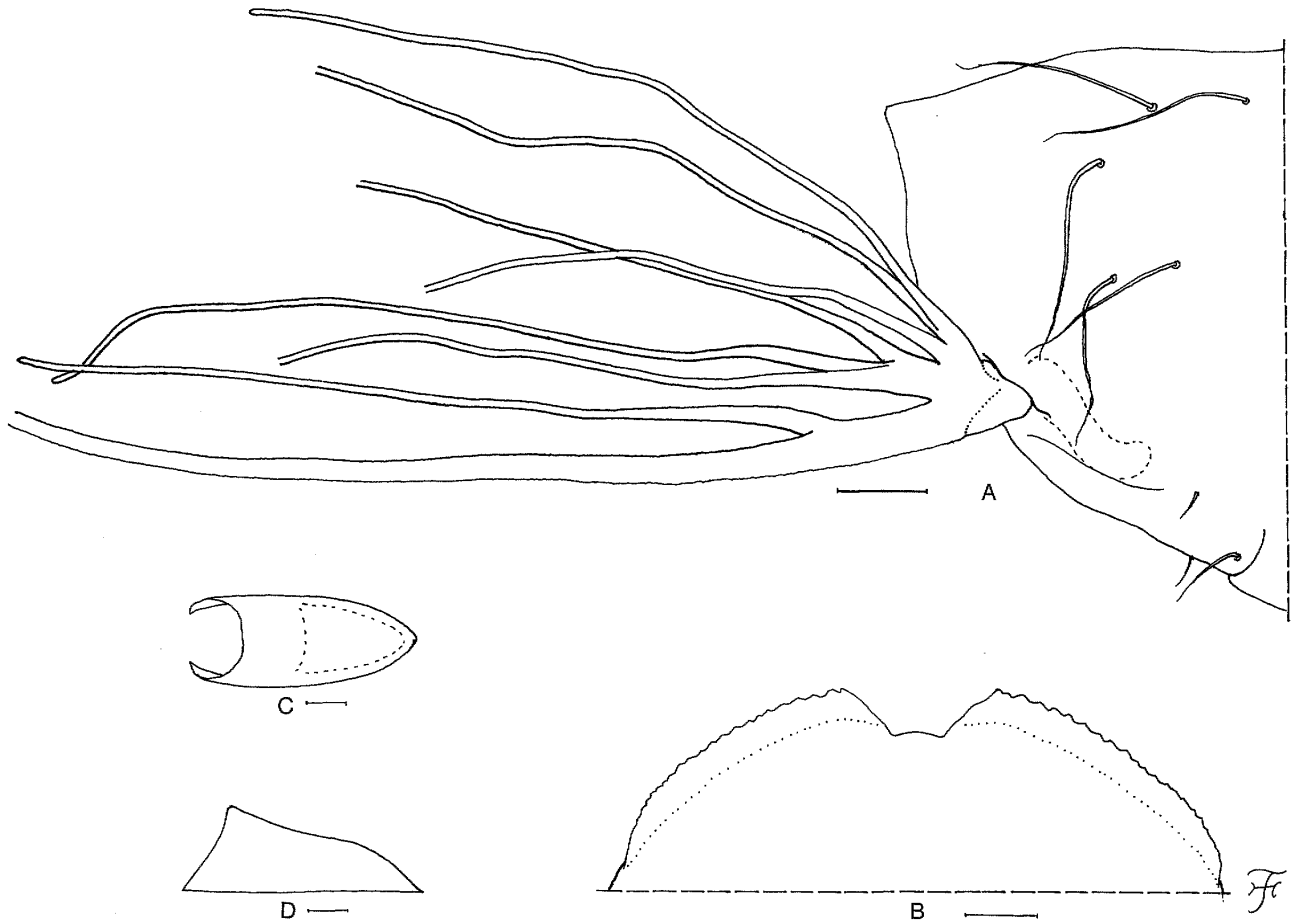

Fig. 2. Pupa of *Simulium* (*Gomphostilbia*) *datfaense* sp. nov. A, gill filaments and anterior part of thoracic integument (left side and dorsal view); B, terminal hooks (end view); C and D, cocoons (C, dorsal view; D, lateral view). Scale bars. 0.5 mm for C and D; 0.1 mm for A; 0.02 mm for B.

(slide mounted), collected from a moderately-flowing stream (width 1.0 m, water temperature 23.5℃, shaded, altitude 250 m) (near the confluence with a main channel) in a natural forest, Tai Rom Yen National Park, Surat Thani Province, Thailand, 15. V. 2009, by H. Takaoka, Y. Otsuka, W. Choochote and S. Thongsahuan. Paratype: One pupal exuviae and cocoon (in ethanol), same data and date as those of the holotype.

ECOLOGICAL NOTES. The pupa and the pupal exuviae were each attached to a slender tree root with a diameter about 1.0 mm trailing in a cascading stream. Associated species were *Simulium* (*Simulium*) *brevipar* Takaoka and Davies, *S.* (*S.*) *malayense* Takaoka and Davies, and *S.* (*S.*) *tani* Takaoka and Davies. [Note: *Simulium brevipar* is now confirmed to occur in Thailand; its presence in Thailand previously was unclear because the closely related species, *S.* (*S.*) *yuphae*, was described from northern Thailand (Takaoka and Choochote, 2005).]

ETYMOLOGY. The species name *datfaense* refers to Dat Fa Waterfalls where this new species was collected.

REMARKS. This new species is assigned to the subgenus *Gomphostilbia* redefined by Takaoka (2003) in that it has the haired katepisternum, the bare pleural membrane in the female, the eight gill filaments arranged in 3+3+2 filaments (Fig. 2A), grapnel-like hooklets and wide plate-like terminal hooks (Fig. 2 B) in the pupa.

This new species is characterized by the arrangement of the eight pupal gill fil-

aments arranged in 3+3+2 filaments lying nearly horizontally from inside to outside, of which the outer filament of the outer paired group is much longer and thicker than seven other filaments which are subequal in length and thickness to one another (Fig. 2 A). The similar arrangement of the pupal gills has been reported in *S.* (*G.*) *whartoni* described from Peninsular Malaysia (Takaoka and Davies, 1995), *S.* (*G.*) *floresense* from Flores, Indonesia (Takaoka et al., 2006) and *S.* (*G.*) *adleri* from Thailand (Jitklang and Kuvangkadilok, 2008). However, six short slender filaments of the two triplet groups have the same width throughout their length (not wider near the base as in this new species) in all these known species, the stalk of the middle triplet group is 0.4–0.6 times as thick as that of the outer paired group in both *S.* (*G.*) *whartoni* and *S.* (*G.*) *floresense*, and the common basal stalk is present, though short, tubercles are absent on the frons, the terminal hooks are not serrated and spine-combs are absent on the ninth abdominal segment in *S.* (*G.*) *adleri*.

The female of this new species is very similar to that of *S.* (*G.*) *whartoni* although limited features were observable for comparison.

This new species is provisionally placed in the *batoense* species-group.

Simulium (*Gomphostilbia*) *otsukai* Takaoka and Choochote sp. nov.

DESCRIPTION. **Male** (dissected out). Only the following features are observable: Body length 2.2 mm. ***Head***. Wider than thorax. Upper eye consisting of 12 vertical columns and 12 horizontal rows of large facets. Face dark brown. Clypeus dark brown, densely covered with yellow scale-like short to medium-long hairs interspersed with several dark brown simple long hairs. Antenna composed of scape, pedicel and 9 flagellomeres. Maxillary palp with 5 segments (3rd to 5th segments of left palp and tip of 5th segment of right palp lost), light brown, proportional lengths of 3rd and 4th segments 1.0: 1.0; 3rd segment (Fig. 3A) of moderate size; sensory vesicle (Fig. 3A) ellipsoidal, small, 0.22 times as long as 3rd segment, and with medium-sized opening. ***Thorax***. Scutum dark brown, densely covered with golden-yellow short hairs. Scutellum dark brown, with golden-yellow short hairs and dark brown long upright hairs. Postnotum dark brown, slightly white pruinose and bare. Pleural membrane bare. Katepisternum medium brown, longer than deep, moderately covered with dark brown short hairs. ***Legs***. Foreleg: coxa yellow; trochanter dark yellow; femur light brown; tibia light to medium brown though extreme base and median portion somewhat lighter; tarsus brownish-black; basitarsus somewhat dilated, 7.93 times as long as greatest width. Midleg: coxa medium brown except posterior surface dark brown; trochanter dark yellow; femur dark yellow with apical cap medium brown; tibia yellow on basal 2/5, with medium brown spot subbasally, and light to medium brown on apical 3/5; tarsus medium to dark brown except basal 1/2 of basitarsus dark yellow. Hind leg: coxa and trochanter dark yellow; femur dark yellow to light brown except apical cap medium brown; tibia yellow on basal 1/2 or little more, with medium brown spot subbasally, and dark brown on remaining apical portion; tarsus medium brown except basal 3/5 of basitarsus and basal 1/2 of 2nd tarsomere yellowish-white though base of basitarsus light brown; basitarsus (Fig. 3B) narrow, nearly parallel-sided, much narrower than tibia and femur; calcipala (Fig. 3B) well developed; pedisulcus (Fig. 3B) appearing to be well defined. ***Wing***. Costa with dark brown spinules and hairs except basal portion with patch of golden-yellow hairs. Subcosta bare. Hair tuft on stem vein golden-yellow. Basal portion of radius fully haired; R_1 with dark brown spinules and hairs; R_2 with dark brown hairs only. Basal cell absent. ***Abdomen***. Basal scale light brown, with fringe of yellow long hairs. Dorsal surface of abdomen medium brown to brownish-black except segment 2 yellow, covered with dark short to long hairs; segments 2 and 5–7 each with pair of shiny dorsolateral patches. ***Genitalia***. Coxite in ventrolateral view (Fig. 3C) nearly rectangular, 1.21 times as long as its greatest width. Style in ventrolateral view (Fig. 3D) boot-shaped, nearly parallel-sided along basal 1/2, then slightly widened toward apex, with round apex having spine; style 0.59

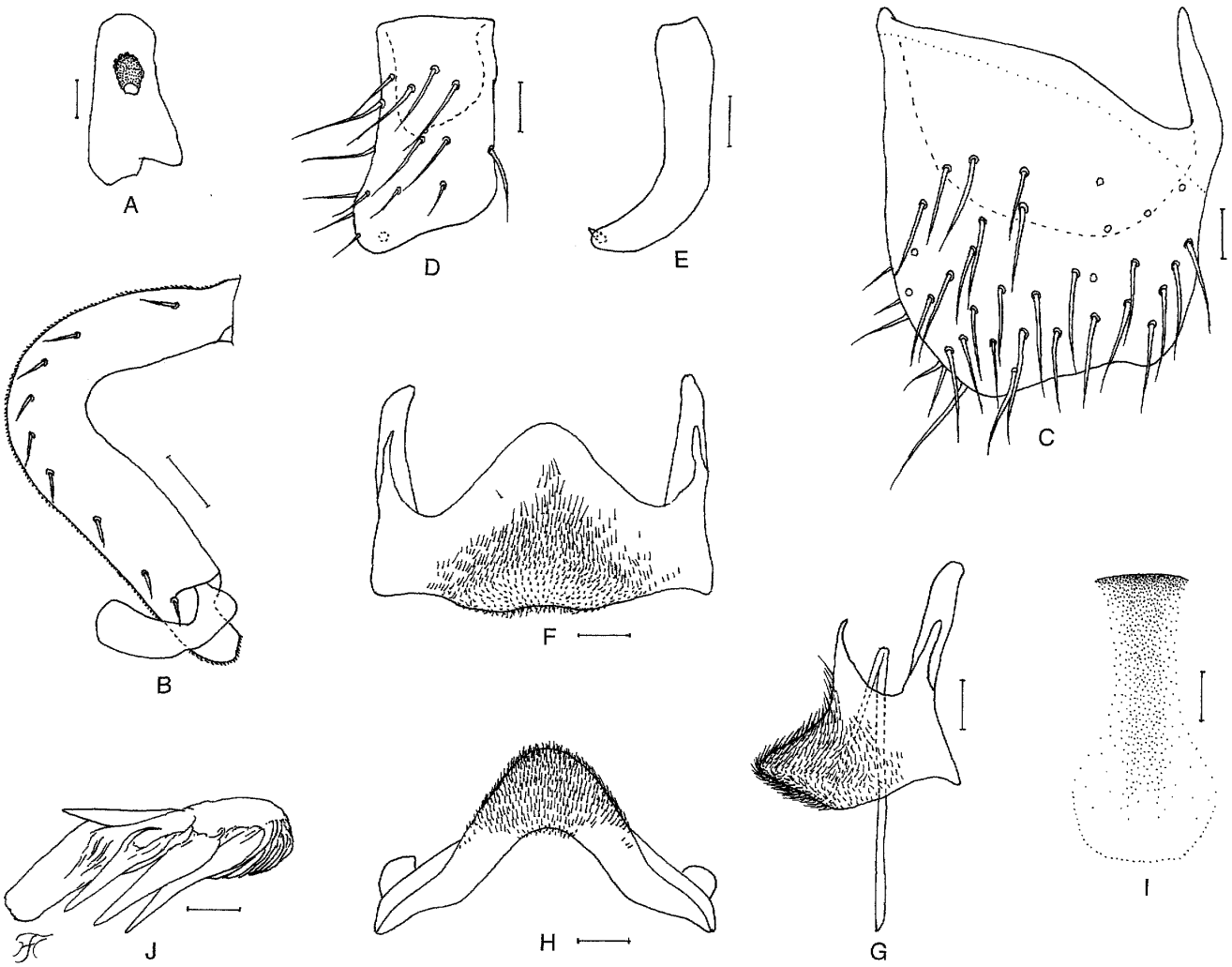

Fig. 3. Male of *Simulium* (*Gomphostilbia*) *otsukai* sp. nov. A, 3rd segment of maxillary palp with sensory vesicle (left side and front view); B, basitarsus and 2nd tarsomere of hind leg showing calcipala and pedisulcus (left side and outer view); C, coxite (ventrolateral view); D and E, styles (left side; D, ventrolateral view; E, medial view); F, ventral plate (ventral view); G, ventral plate and median sclerite (lateral view); H, ventral plate (end view); I, median sclerite (ventral view); J, paramere (right side and end view). Scale bars. 0.05 mm for B; 0.02 mm for A and C–J.

times as long as coxite, 2.09 times as long as width at base; style in medial view (Fig. 3E) slender, markedly curved inward, nearly parallel-sided along basal 2/3, then tapered toward apex. Ventral plate in ventral view (Fig. 3F) transverse, 1.73 times as wide as length at middle, slightly widened posteriorly, with anterior margin produced anteromedially, and posterior margin undulate, and densely covered with microsetae medially on ventral surface; basal arms of moderate length, nearly parallel-sided; ventral plate in lateral view (Fig. 3G) much produced ventrally, with posterior margin sinuous, and arms straight; ventral plate in end view (Fig. 3H) much produced ventrally, and densely covered with microsetae on posterior surface except both lateral areas mostly bare. Median sclerite (Fig. 3G, I) connected to ventral plate near anterior margin, directed posteriorly; median sclerite plate-like, wide, moderately sclerotized except apex. Paramere (Fig. 3J) of moderate size, with 4 distinct long and stout hooks and several smaller ones close together near apex. Aedeagal membrane transparent, densely covered with minute setae, not sclerotized basally, and not forming dorsal plate. Ventral surface of 10th abdominal segment forming moderately sclerotized plate anteriorly, without distinct hairs near posterior margin on each side. Cercus rounded, with 9–12 hairs.

Pupa. Body length 2.2 mm. ***Head***. Integu-

ment yellow, moderately and uniformly covered with small round tubercles; antennal sheath without any protuberances or tubercles; frons with 3 pairs of simple very long trichomes with or without coiled apices, and face with pair of simple very long trichomes with coiled apices; 3 frontal trichomes on each side arising close together, subequal in length to one another and slightly longer than facial one. ***Thorax***. Integument yellow, moderately covered with tubercles, with 3 simple very long mediodorsal trichomes with coiled apices, 1 simple very long anterolateral trichome with coiled apex (another trichome lost), 1 simple medium-long posterolateral trichome with uncoiled apex and 3 simple ventrolateral trichomes with uncoiled apices (2 long, 1 short) on each side. Gill (Fig. 4A, B) composed of 8 slender thread-like filaments, arranged in groups of 1+1+2+[1+(1+2)] filaments from dorsal to ventral (though branching level of 4 filaments of ventral group different on each side): all filaments slightly becoming longer from dorsal to ventral (1.0–1.4 mm in length); common basal stalk short, with somewhat swollen transparent organ ventrally at base; all filaments light brown, gradually tapered toward apex; annular ridges and furrows marked except basal portion of most filaments without ridges and furrows; all filaments densely covered with minute tubercles. ***Abdomen***. Dorsally, segment 1 light yellow, almost bare except minute tubercles medially along anterior margin (seta on each side lost); segment 2 light yellow, with 1 simple short hair-like seta and 5 very short setae submedially on each side; segments 3 and 4 each with 4 hooked spines and 1 very short somewhat spinous seta on each side; segment 5 lacking spine-combs; segments 6–9 each with spine-combs in transverse row and comb-like groups of minute spines on each side; segment 9 with pair of distinct flat plate-like terminal hooks extending laterally and having weakly serrated outer margin (Fig. 4C). Ventrally, segment 5 with pair of bifid hooks submedially and few very short simple slender setae on each side; segments 6 and 7 each with pair of bifid or trifid inner and simple outer hooks somewhat spaced from each other and few very short simple slender setae on each side. (It is uncertain whether spine-combs on segment 5 and grapnel-like hooklets on each side of segment 9 are present or not due to damage of the specimen). ***Cocoon***. Similar to that of *S.* (*G.*) *datfaense* sp. nov.; 3.0 mm long by 1.4 mm wide.

Female and **Mature larva**. Unknown.

TYPE SPECIMEN. Holotype male with its associated pupal exuviae and cocoon (slide mounted), reared from a pupa collected from a moderately-flowing stream (width 2 m, water temperature 23.0℃, shaded, altitude 280 m) in a natural forest, Tai Rom Yen National Park, Surat Thani Province, Thailand, 15. V. 2009, by H. Takaoka, Y. Otsuka, W. Choochote and S. Thongsahuan.

ECOLOGICAL NOTES. The pupa of this new species was attached to a slender grass root 0.4 mm in diameter trailing in a stream. Associated species were *S.* (*G.*) *angulistylum* Takaoka and Davies, *S.* (*G.*) *parahiyangum* Takaoka and Sigit, *S.* (*S.*) *brevipar*, and *S.* (*S.*) *tani*.

ETYMOLOGY. The species name *otsukai* is in honor of Mr. Yasushi Otsuka, Research associate, Department of Infectious Disease Control, Faculty of Medicine, Oita University, who made a great contribution in molecular taxonomy of black flies, in particular, in a phylogenetic analysis of the three subgenera (*Asiosimulium*, *Daviesellum* and *Wallacellum*) endemic to the Oriental Region.

REMARKS. *Simulium* (*G.*) *otsukai* sp. nov. is assigned to the *batoense* species-group within the subgenus *Gomphostilbia* in that it has antennae with 11 segments, the pleural membrane bare, and a slender hind basitarsus (Fig. 3B) in the male, and eight gill filaments (Fig. 4A, B) in the pupa.

This new species is easily distinguished from all the known species by the unique arrangement of the eight pupal gill filaments, i.e., 1+1+2+[1+(1+2)] from dorsal to ventral (Fig. 4A, B).

The male of this new species is characterized by the broad inwardly twisted style (Fig. 3D). The similar shape of the style is seen in a few species within

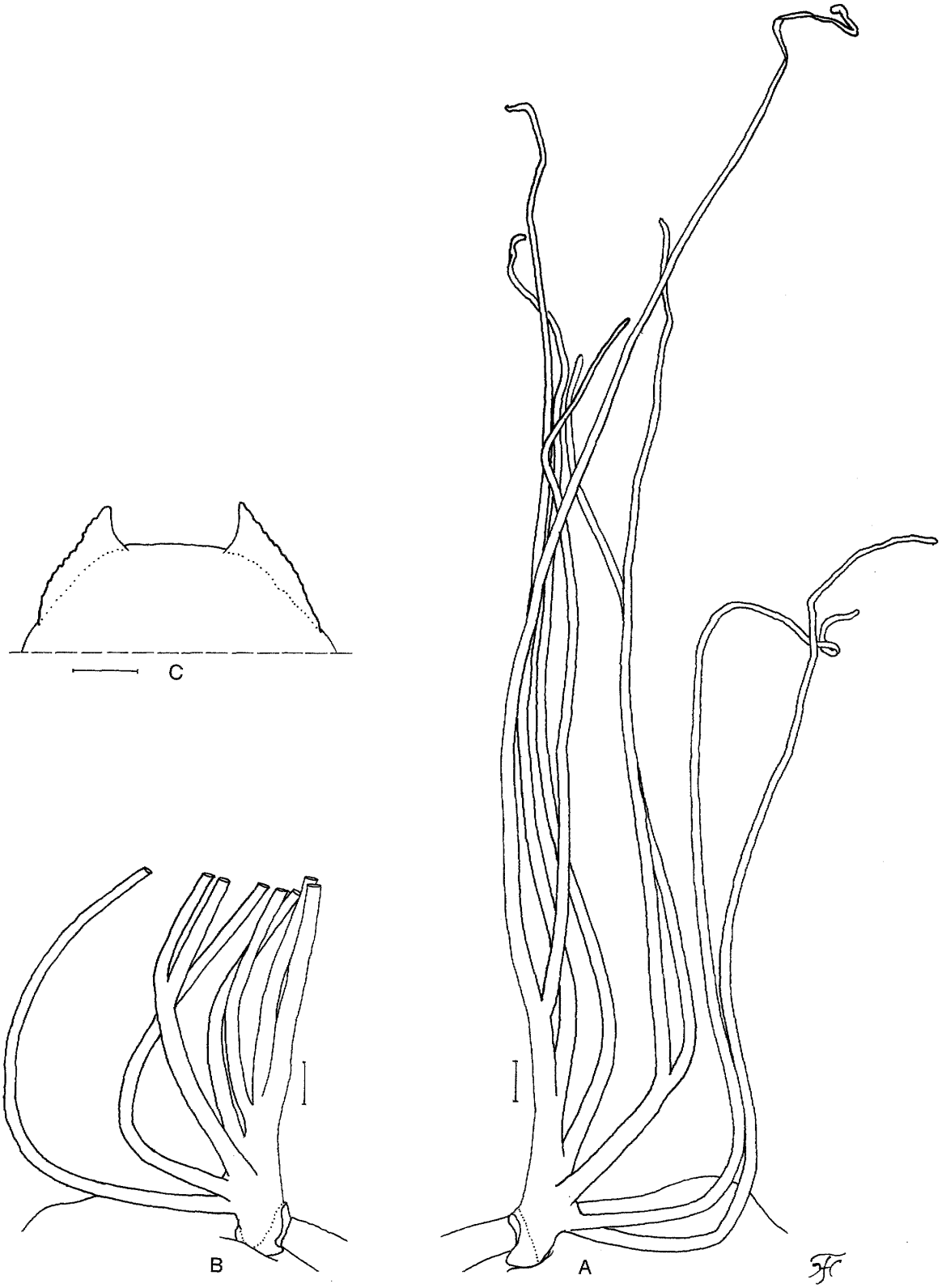

Fig. 4. Pupa of *Simulium* (*Gomphostilbia*) *otsukai* sp. nov. A, gill filaments (left side and lateral view); B, basal 1/3 of gill filaments (right side and lateral view); C, terminal hooks (end view). Scale bars. 0.05 mm for A and B; 0.02 mm for C.

the subgenus *Gomphostilbia*, i.e., *S.* (*G.*) *angulistylum* from Peninsular Malaysia and Thailand (Takaoka and Davies, 1995), *S.* (*G.*) *auratum* Takaoka from Sarawak, Malaysia (Takaoka, 2009) and *S.* (*G.*) *epistum* Delfinado from Palawan Island, the Philippines (Delfinado, 1971; Takaoka, 1983), although all these known species differ in the arrangement of the pupal gills from this new species.

Simulium (*Gomphostilbia*) *cheongi* Takaoka and Davies

Simulium (*Gomphostilbia*) *cheongi* Takaoka and Davies, 1995: 37–42 (female, male, pupa and larva).

SPECIMENS EXAMINED. Two males reared from pupae, collected from a small stream (width 0.5 m, water temperature 25.0℃, shaded, altitude 100 m) slowly flowing in a rubber tree plantation, near the entrance of Phrom Lok Waterfalls, Khao Luang National Park, Nakorn Si Thammarat Province, southern Thailand, 19. V. 2009, by H. Takaoka, Y. Otsuka, W. Choochote and S. Thongsahuan.

ECOLOGICAL NOTES. The two pupae of this species were each attached to a fallen tree leaf in the water. The only associated species was *S.* (*G.*) *trangense* Jitklang, Kuvangkadilok, Baimai, Takaoka and Adler.

DISTRIBUTION. Peninsular Malaysia and Thailand (**new record**).

REMARKS. This species belongs to the *batoense* species-group, and is characterized in the male by the almost entirely yellow antennae and in the pupa by the gill composed of one long and seven short filaments arranged as (3+3)+2 from dorsal to ventral and plate-like terminal hook with a serrated outer margin (Takaoka and Davies, 1995). The pupal gill of this species is somewhat similar in the arrangement to that of *S.* (*G.*) *datfaense* sp. nov. but distinguished by all the short gill filaments of the same width throughout their length and two triplets sharing a short stalk.

The morphological features of the males reared from pupae collected in Thailand agree with those in the original description although the antennae are yellow except one or two apical flagellomeres which are somewhat darkened (entirely yellow in the original description) and the upper eye consists of large facets in 11 vertical columns and 12 horizontal rows on each side (in 10 vertical columns and 11 horizontal rows in the original description).

Acknowledgements

We are grateful to Prof. Peter H. Adler, Clemson University, U.S.A. for reading the manuscript and giving valuable comments. Special thanks are due to Mr. Lek Thongsahuan, Mrs. Sawalee Thongsahuan, and Miss Salintorn Thongsahuan, Trang Province, for their kind help in various ways during our surveys in southern Thailand. This study was in part supported by a Grant-in-Aid for Oversea Research from the Japan Society for the Promotion of Science to H. T. (No. 18406011).

References

Adler, P. H. and Crosskey, R. W. 2009. World Blackflies (Diptera: Simuliidae): A Comprehensive Revision of the Taxonomic and Geographical Inventory [2009]. 100 pp., http://entweb.clemson.edu/biomia/pdfs/blackflyinventory.pdf

Delfinado, M. 1971. Some Simuliidae and Curtonotidae from the Philippines and the Bismarck Islands (Insecta, Diptera). *Steenstrupia*, 1: 131–139.

Jitklang, S. and Kuvangkadilok, C. 2008 [2007]. A new species of *Simulium* (*Gomphostilbia*) (Diptera: Simuliidae) from southern Thailand, with description of its polytene chromosomes. *Studia dipterologica*, 14: 369–375.

Takaoka, H. 1983. The Blackflies (Diptera: Simuliidae) of the Philippines. xii+199 pp., Japan

Society for the Promotion of Science, Tokyo.
Takaoka, H. 2003. The Black Flies (Diptera: Simuliidae) of Sulawesi, Maluku and Irian Jaya. xxii+581 pp., Kyushu University Press, Fukuoka.
Takaoka, H. 2009. Three new species of *Simulium* (*Gomphostilbia*) (Diptera: Simuliidae) from Sabah and Sarawak, Malaysia. *Med. Entomol. Zool.*, 60: 97–112.
Takaoka, H. and Choochote, W. 2005. Two new species of black flies (Diptera: Simuliidae) from northern Thailand. *Med. Entomol. Zool.*, 56: 319–334.
Takaoka, H. and Davies, D. M. 1995. The Black Flies (Diptera: Simuliidae) of West Malaysia. viii+175 pp., Kyushu University Press, Fukuoka.
Takaoka, H., Hadi, U. K. and Sigit, S. H. 2006. The black flies (Diptera: Simuliidae) of Flores and Timor, Indonesia. *Med. Entomol. Zool.*, 57: 1–26.